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among farmers subject to their inroads that they cannot be caught in traps. Mr. Bailey especially commends the use of bisulphide of carbon for their destruction, which is readily accomplished by placing an ounce or two of this volatile fluid on cotton or rags in their burrows. Instructions are also given for the use of poison and traps. In consequence of the harm done by Gophers, bounties have been offered in many parts of the West, but the system is condemned as a means of depleting the county treasuries without effecting the extirpation of the Gophers. Thus it is stated that Benton county, Iowa, paid out \$18,000 in three years in Gopher bounties, "but the Gophers, though greatly reduced in numbers, were not exterminated."

Gophers of one species or another occupy practically the whole of the United States west of the Mississippi River, and also the greater parts of the States of Illinois, Georgia, Alabama and Florida. Detailed accounts are given of the habits of the various species found east of the Rocky Mountains. Aside from its important economic bearings, the Gopher Bulletin is a most interesting contribution to the life history of a group of animals hitherto little known. Four of the six illustrations in the text are from Dr. Merriam's monograph, as are the frontispiece (Georgia Gopher), and the colored map of the distribution of the species of the genera *Geomys* and *Craterogeomys*. The two colored plates (of the Prairie Gopher and Gray Gopher), called for in the list of illustrations, and prepared especially for this Bulletin, are lacking, in consequence, as we are privately informed, of their having been 'misaid' at the Government Printing Office after their production and delivery by the Department of Agriculture.

J. A. ALLEN.

[*The Norway Lemming*] *Myodes lemmus*, its *Habits and Migrations in Norway*, by R. Collett. Christiania. 1895. 8°. pp. 62.

The distinguished naturalist of Christiania, Dr. R. Collett, has just published a treatise on the Norwegian Lemming that at once becomes a classic on the subject. He tells us that, in a manuscript believed to have been written in the latter half of the 13th century, the Lemmings are supposed to have been the same as the 'locusts' mentioned in the Bible in connection with the plagues in Egypt. In a book published by Jacob Ziegler in 1532 the theory of their descent from the clouds is proposed, based on statements of two bishops from Trondhjem. In 1555 Olaus Magnus, Archbishop of Upsala, published a figure showing the Lemmings (with tails like house mice) falling from the clouds and being preyed upon by Ermines.

Dr. Collet states that normally the Lemming inhabits all of the mountain plateaus of Norway above the zone of coniferous trees, descending in Finmark to sea level, thus occupying about one-third of the total land area. Besides the mainland they inhabit the large rocky islands off the coast, especially to the northward.

In normal years they are rarely seen, even by explorers. In prolific years they suddenly increase and overflow vast areas. In such years according to Dr. Collet, "The litters produced during the course of the summer follow so closely one upon the other that the one set is barely allowed time to leave the nest ere the next lot arrives. Furthermore, the litters are unusually large, as they constantly contain up to 10 younglings in each set (although possibly 6 or 7 on the whole is the rule); and all these young ones appear to be possessed of greater powers of attaining maturity than those produced during a normal year."

This excessive reproduction results in overcrowding the breeding grounds, from which vast numbers move away in different directions. Descending the mountains and following the valleys they continue blindly

on, proceeding hopelessly to certain death. The direction of the march is dependent on the valleys, and the exodus may "radiate in quite opposite directions from one and the same mountain plateau. * * * * Thus during migratory years the southern ramifications of the Lang Fjeld will emit swarms which may advance eastward as far as the Christiania Fjord; southward, down to the coastal regions of Christiania Stift; and westward, to the fjords in the counties of Stavanger and Søndre Bergenhus. * * * During the entire course of the summer and autumn, they continue to pour forth from the mountains. * * * * In the valleys they invariably meet with lakes or rivers, and large numbers constantly endeavor to cross them. If the mountains are high on both sides, the valley will, as a rule, receive contributions from each slope, and individuals may be observed crossing the river in both directions."

"During the migrations they do not allow themselves to be stopped by rivers, or even by the arms of a fjord, but trust themselves, without hesitation, to the mercy of the waves, in order to reach the opposite shore. It would almost seem as if no stretch of water were too wide for them to cross if they but see land on the other side. During the great migration in the district of Trondhjem in 1868, which has previously been mentioned, a steamer on the Trondhjem Fjord steamed into a crowd of swimming Lemmings of such vast extent that she took over a quarter of an hour to pass through it, and as far as one could see from the vessel down the fjord its waters were covered everywhere with these animals. During the great migratory years similar accounts are received from all the great lakes (Mjösen, Randsfjord, Kröderen, etc., etc.)."

Great havoc is wrought in meadows and grain fields by the hungry hordes, particularly in mountain pastures and farms situated on the higher slopes.

It is stated that no rule can be laid down concerning the frequency of the migratory years. The greatest migrations, which extend down to the most distant lowlands, take place but seldom and rarely occur in the southern districts oftener than once in ten years. The number Dr. Collett has collected data for is surprising. He gives the dates and areas invaded for seven great migrations from 1739 to 1790, and for no less than 24 in the present century.

As to the extent of the areas invaded, Dr. Collett says: "On the whole it may be assumed that scarcely any accessible point of Norway (except the outermost islets) has not been invaded by their hordes during one or other prolific year."

"It has hardly ever happened that a prolific year (and the consequent migration) has simultaneously embraced the entire land. The rule is that the increase takes place in great or small districts independent of each other, but the area which may be involved thereby may be of very considerable extent. Occasionally the increase will take place simultaneously in two separate districts, divided from each other by an area of greater or lesser extent, in which the production is normal. In Norway there may be recognized, on the whole, at least five great groups of mountains within which most of the migrations have their radiating centre. One migration may embrace either the entire group or small portions of it."

The regular enemies of the Lemming are numerous and many of them increase with the Lemmings; as the birds of prey, the large gulls and skuas, and weasels and foxes. In prolific years certain birds which follow the Lemmings change their breeding grounds and nest in localities where they are never seen at other times. To these may be added certain irregular enemies; for Dr. Collett tells us that reindeer (both wild and domesticated), cows, goats and pigs kill and eat them in great numbers.

But the destruction of the Lemmings after reaching the lowlands is only in small part due to these enemies. "The most active factor in their extermination," says Dr. Collett, "appears to be infectious diseases, which invariably occur whenever a species of animal has multiplied in excess of its natural numbers."

Not only do the Lemmings themselves die of disease; but they are believed to cause serious disease among the human population. This belief has been current in Norway from time immemorial and was published by Ziegler more than 350 years ago. Dr. Collett states that during Lemming years all running water is contaminated by the decaying excrement. "To this may be added the dead animals, which will be found lying scattered about in great numbers, and which, during hot summers, become quickly decomposed. The rain carries the putrid matter on to the nearest watercourse, whence it makes its way to wells, and becomes mixed with the drinking water of the inhabitants.

"During some great prolific years, definite forms of sickness have appeared in certain of the overrun districts, and the people have given these the name of 'Lemming Fever,' as they presumed that they were connected with the appearance of these animals."

After citing medical testimony and describing the disease, Dr. Collett concludes: "Lemming fever is thus a disease which, in its phenomena, is related to scarlet fever. Its origin is regarded, both by medical men and the populace, as having a certain connection with the appearance of the swarms of Lemmings and the pollution of water by their putrifying carcasses and dung during dry summers."

Dr. Collett's treatise on the *Habits and Migrations of the Lemming in Norway* is replete with interest from beginning to end and must long remain the standard authority on the subject.

C. H. M.

NOTES AND NEWS.

ASTRONOMY.

THE London *Times* gives the following accounts of recent lectures before the Royal Institution and of the last meeting of the British Astronomical Association:

Dr. W. Huggins, F. R. S., gave the second of his course of lectures on the instruments and methods of spectroscopic astronomy, at the Royal Institution, on May 30th. He dealt with the more complex instrument which is placed at the eye-end of the telescope so that the images of the stars fall upon its slit. The important question of its efficiency was connected, the lecturer said, with its power to break up the spectrum into as many parts as possible. This power of separation was fixed by certain conditions—the linear length of the spectrum, its dispersion, and the resolving power of the prism. The latter, which was independent of dispersive power, was governed by the size of the prism, hence larger prisms have greater resolving power. But the use of larger prisms in astronomical work entailed certain disadvantages, such as increased weight and cost, and difficulty of obtaining glass of uniform quality. It was therefore fortunately possible to get the results of large prisms by passing the beam through several smaller ones, though the loss of light by absorption and reflection from the faces of the prisms was very serious. An alternative way of obtaining a spectrum was to use a diffraction grating, which we owed to the experiments Fraunhofer made to discover whether the lines of the spectrum were due to interference of light. His original gratings were made by winding wire in a screw-thread round a piece of glass; ultimately he adopted the plan of ruling the lines on glass with a diamond point. Great advances were made by Rutherfurd, whose machine cut lines to the number of 17,000 to an inch, and by Rowland. There is, however, but little to choose